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(54) **HIGH DENSITY MEMORY CARD USING FOLDED FLEX**

(75) Inventors: **Lee J. Smith**, Chandler, AZ (US);
Jeffrey Alan Mijs, Chandler, AZ (US);
Curtis Michael Zwenger, Chandler, AZ (US); **Barry Michael Miles**, Chandler, AZ (US)

(73) Assignee: **Amkor Technology, Inc.**, Tempe, AZ (US)

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(52) **U.S. Cl.**
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(58) **Field of Classification Search**
USPC 235/441, 451, 492
See application file for complete search history.

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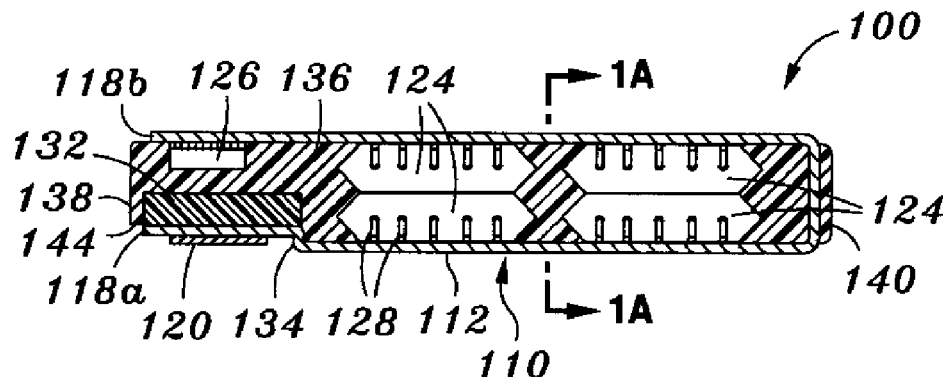
Primary Examiner — Matthew Mikels

(74) *Attorney, Agent, or Firm* — Kevin B. Jackson

(57) **ABSTRACT**

A memory card comprising a flexible substrate (a “flex”) which is integrated in the memory card and folded in a prescribed manner subsequent to having various active and passive devices (e.g., controller and memory devices) surface mounted thereto. The active and passive devices are attached to a common side of the flex, and electrically connected to a conductive pattern disposed thereon. The conductive pattern itself electrically communicates with external signal contacts also formed on the flex. The use of folded flex technology in the memory card of the present invention allows the same to support four or more standard, pre-packaged memory devices, thus providing the memory card with substantially increased capacity.

20 Claims, 8 Drawing Sheets



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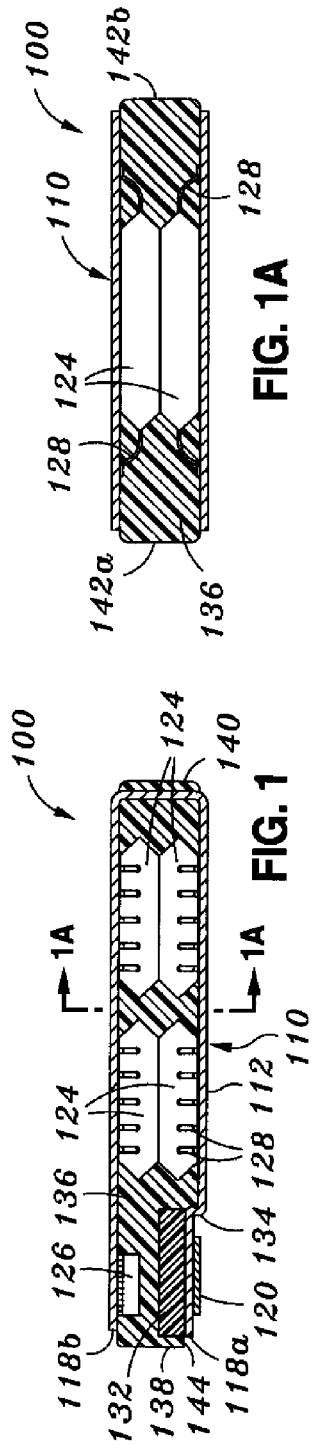


FIG. 1A

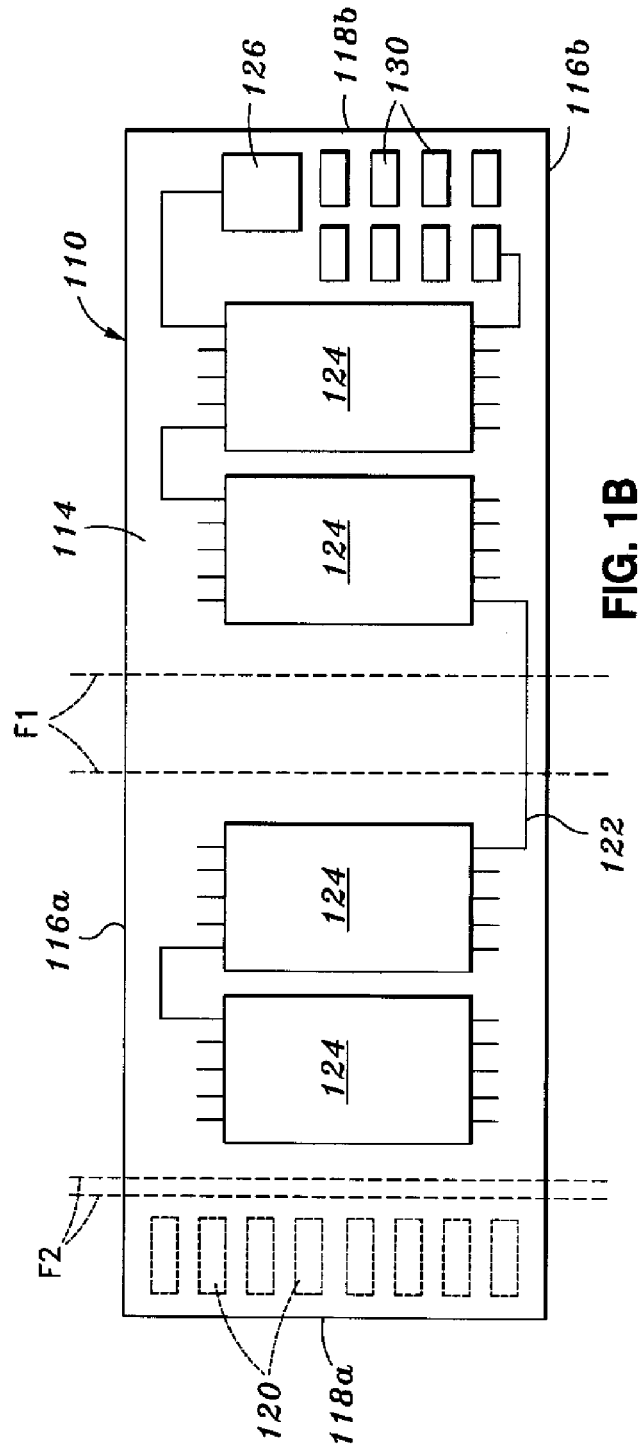
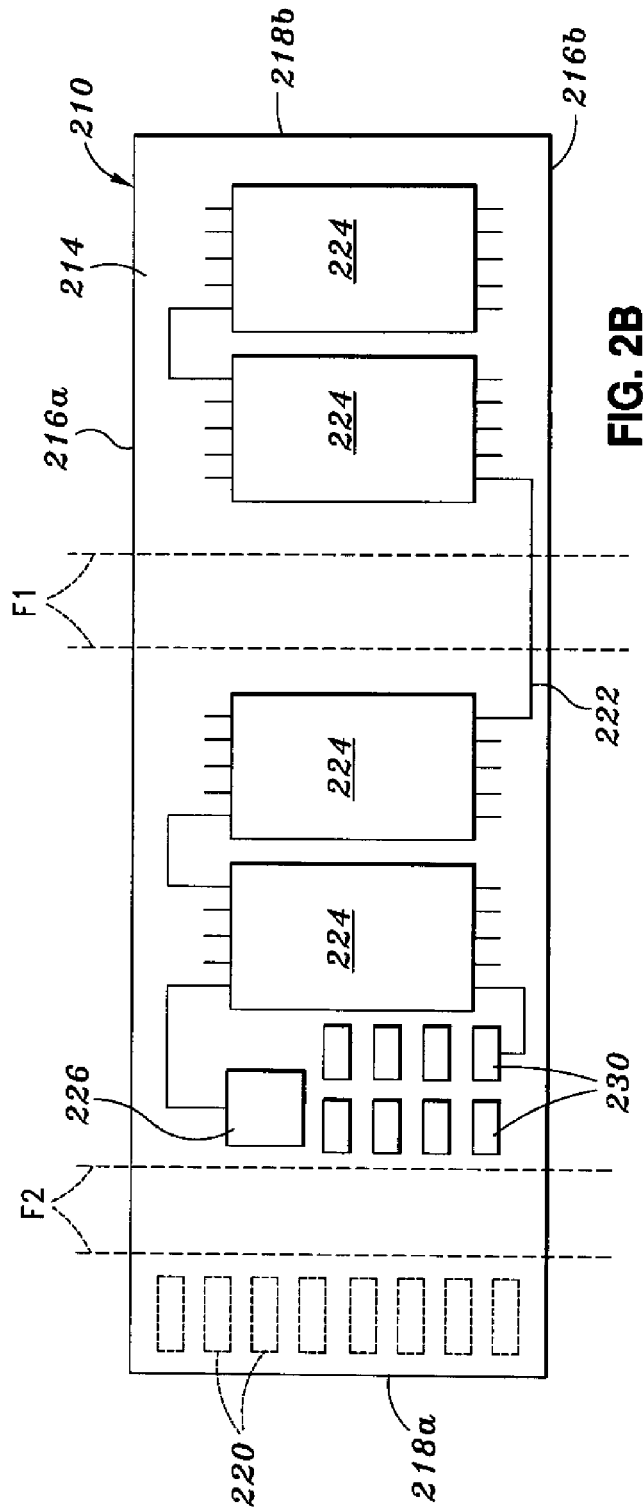
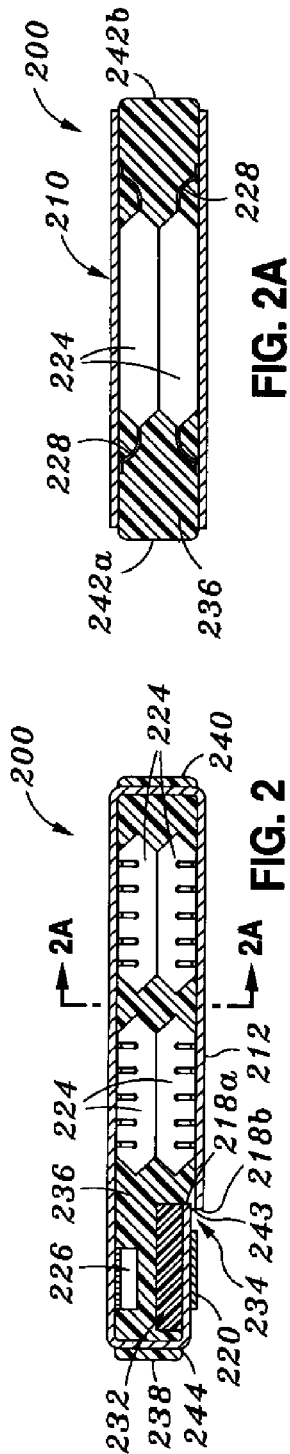
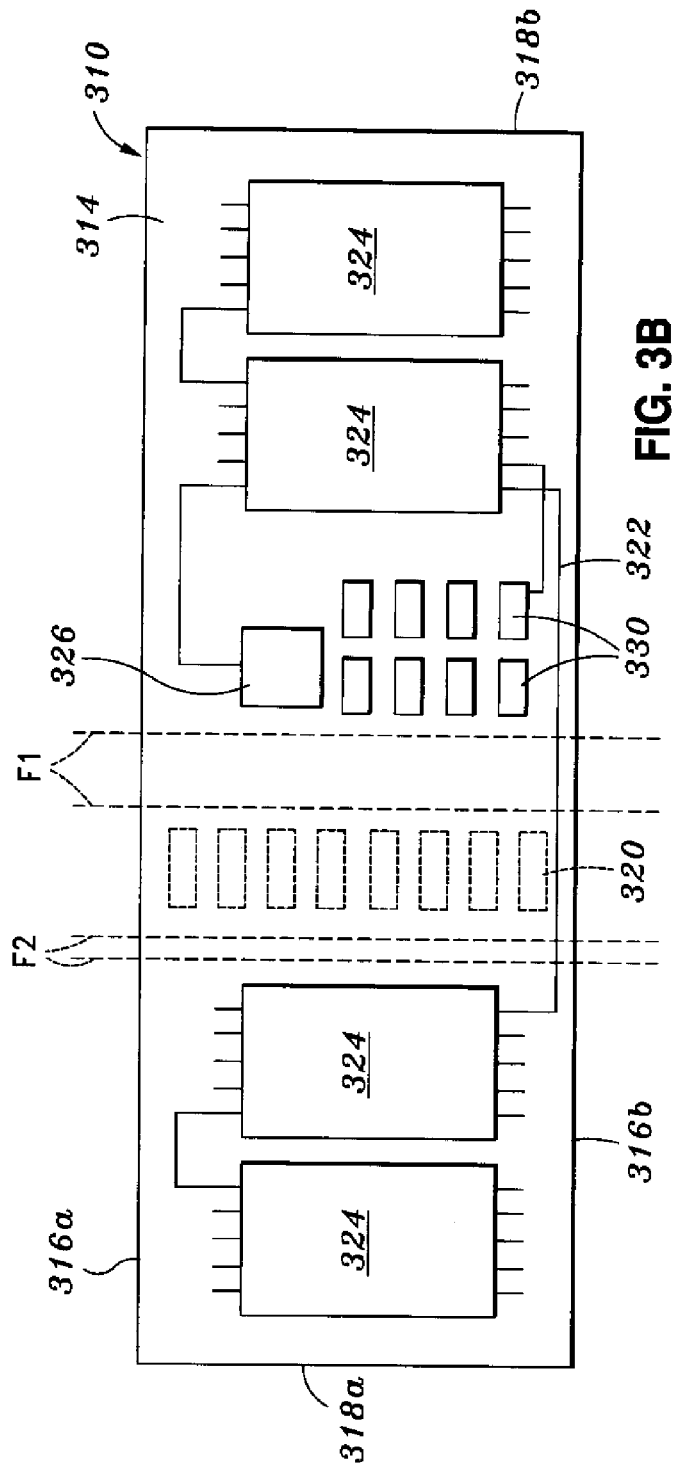
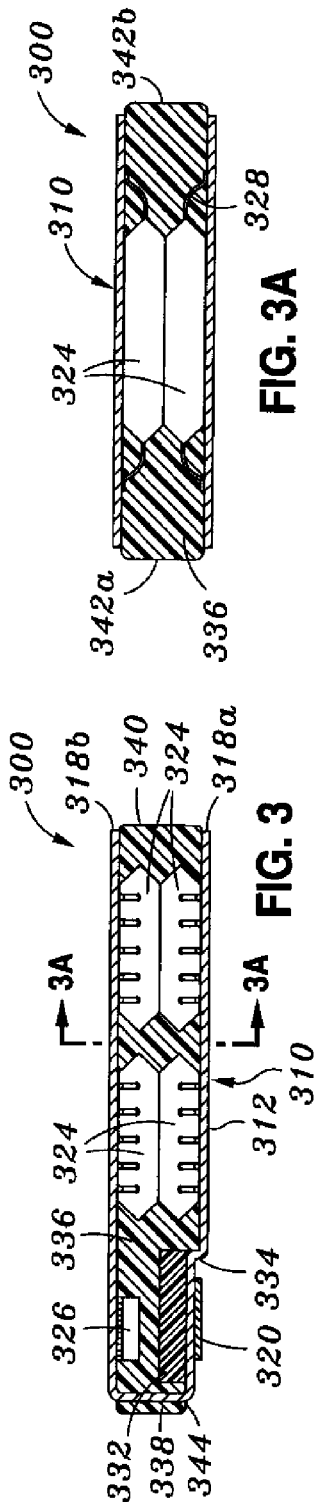


FIG. 1B





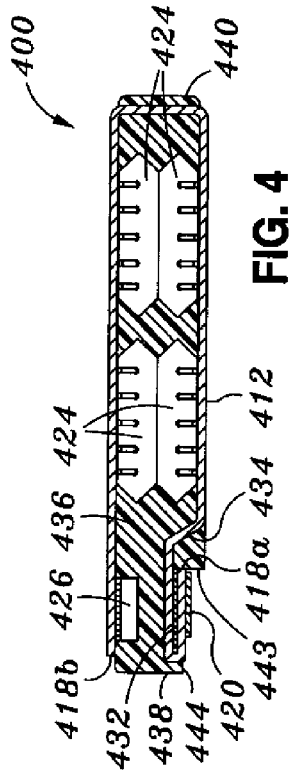


FIG. 4

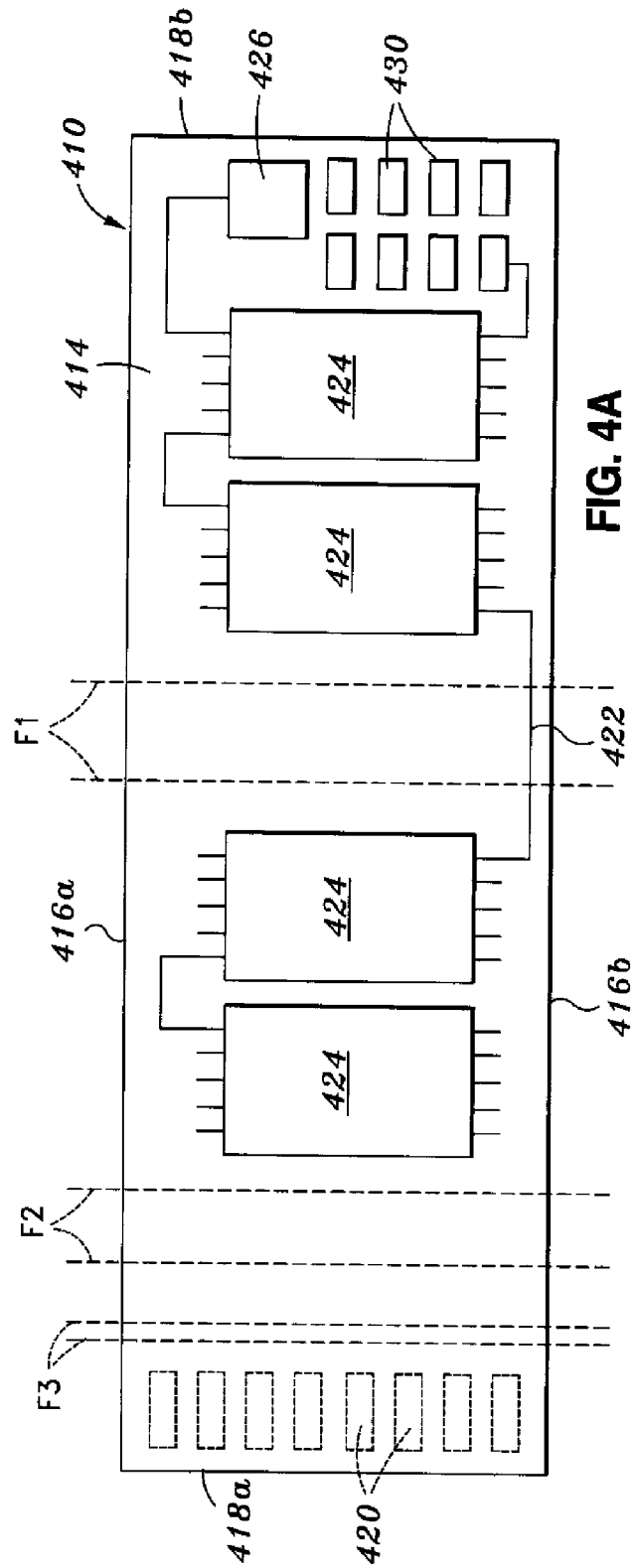
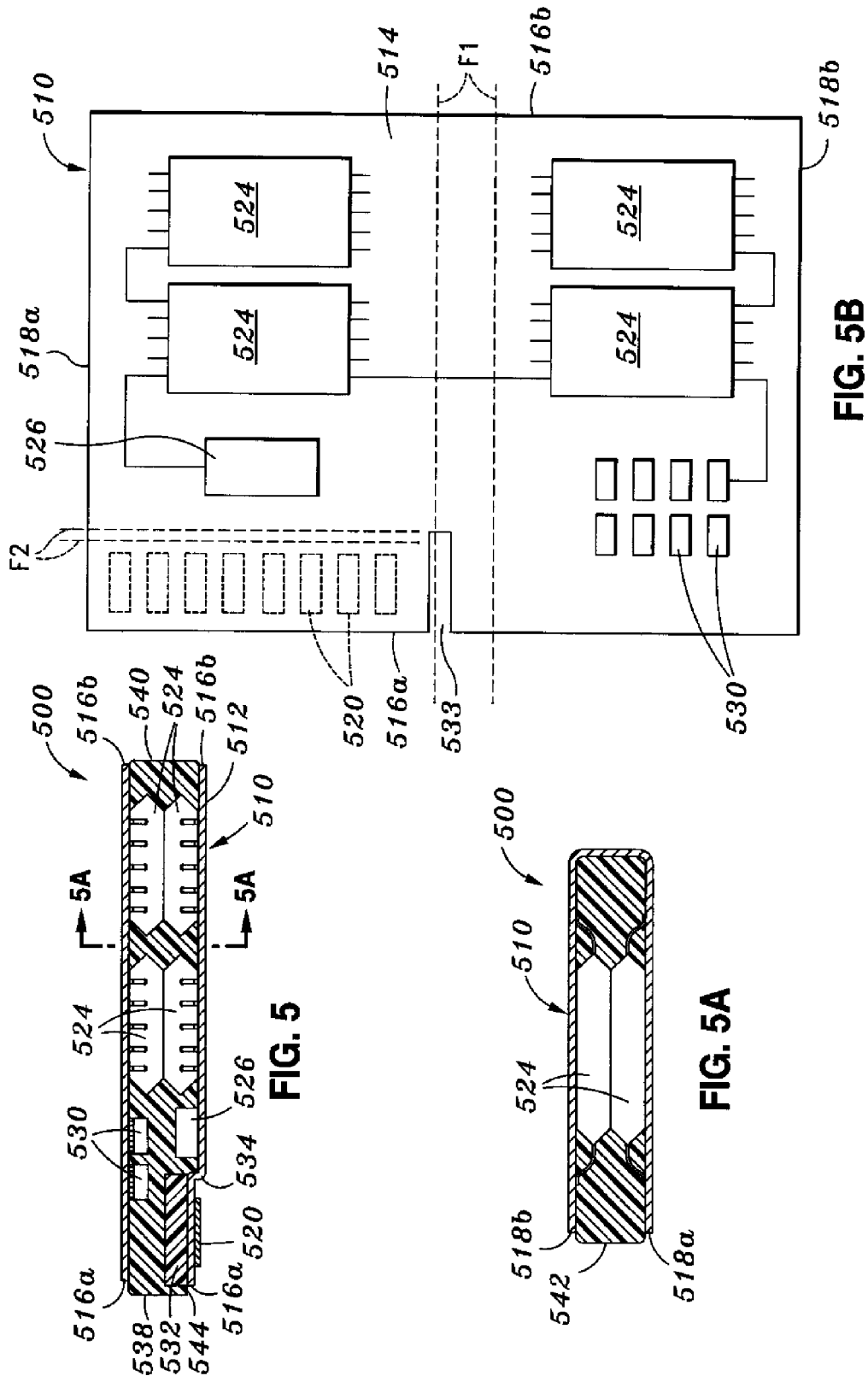


FIG. 4A



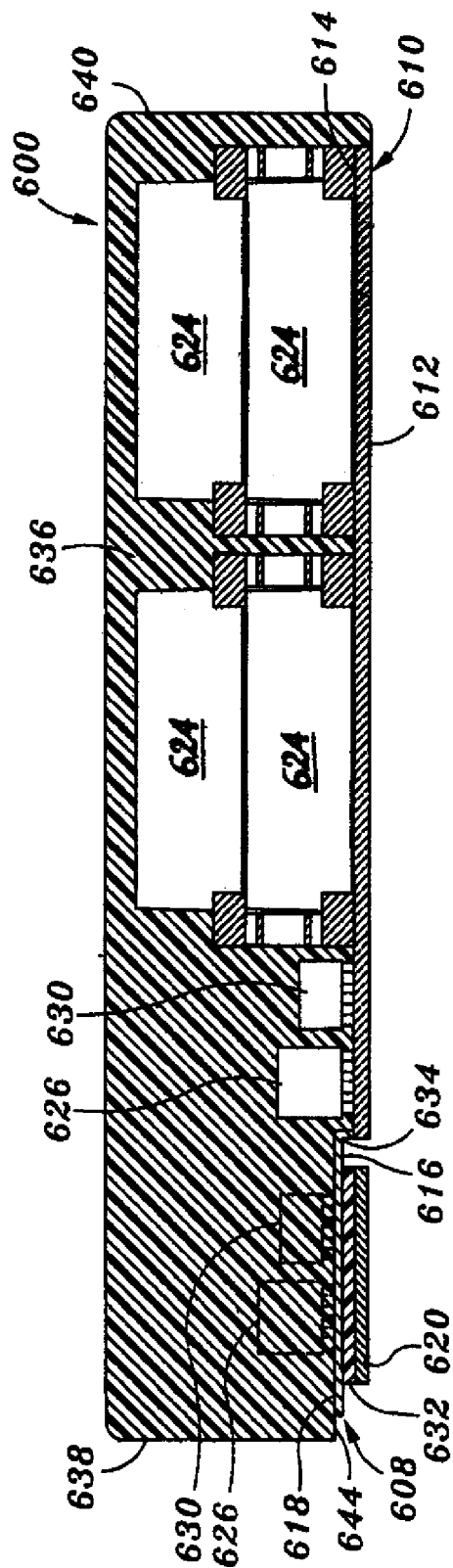


FIG. 6

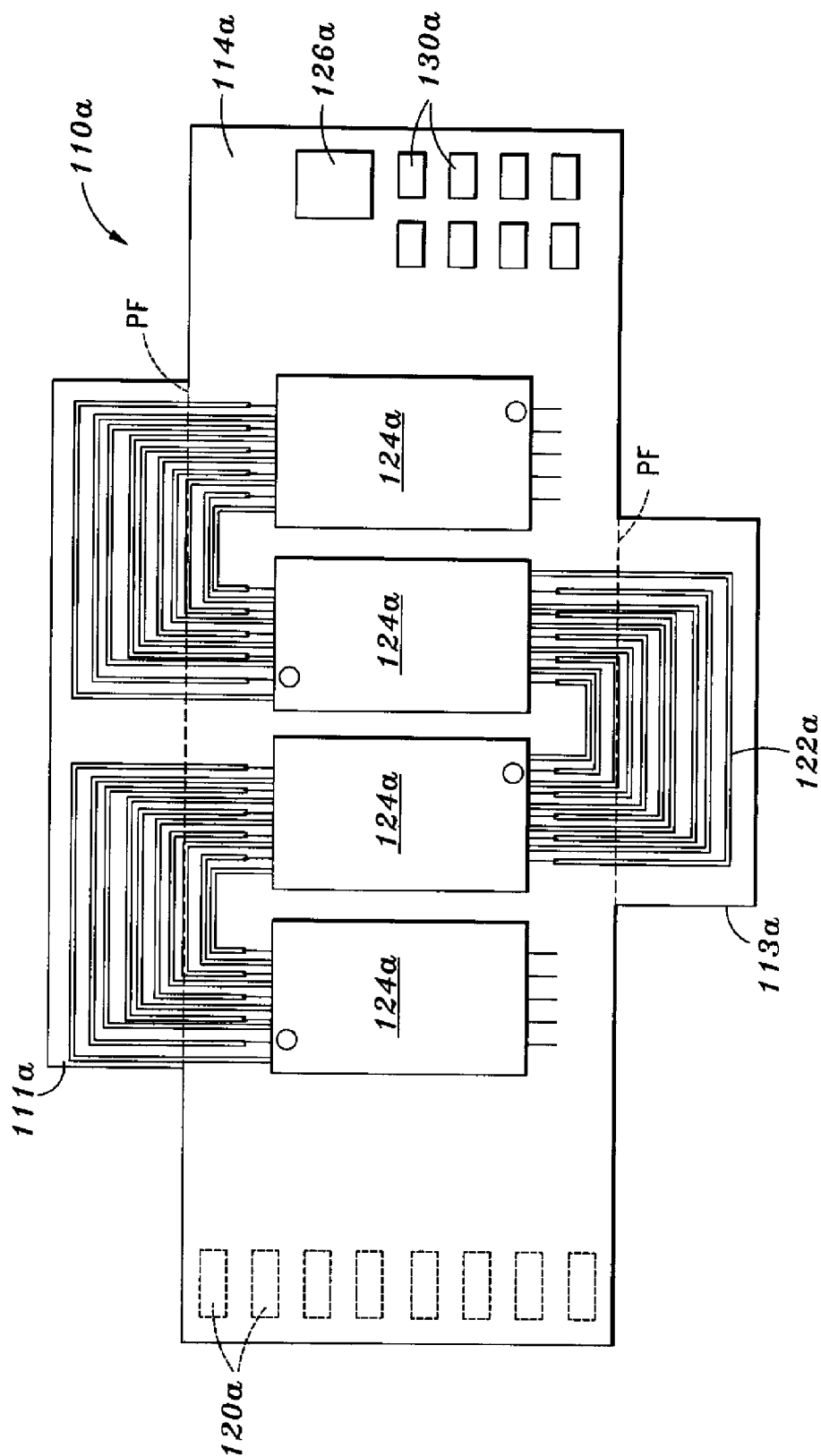


FIG. 7

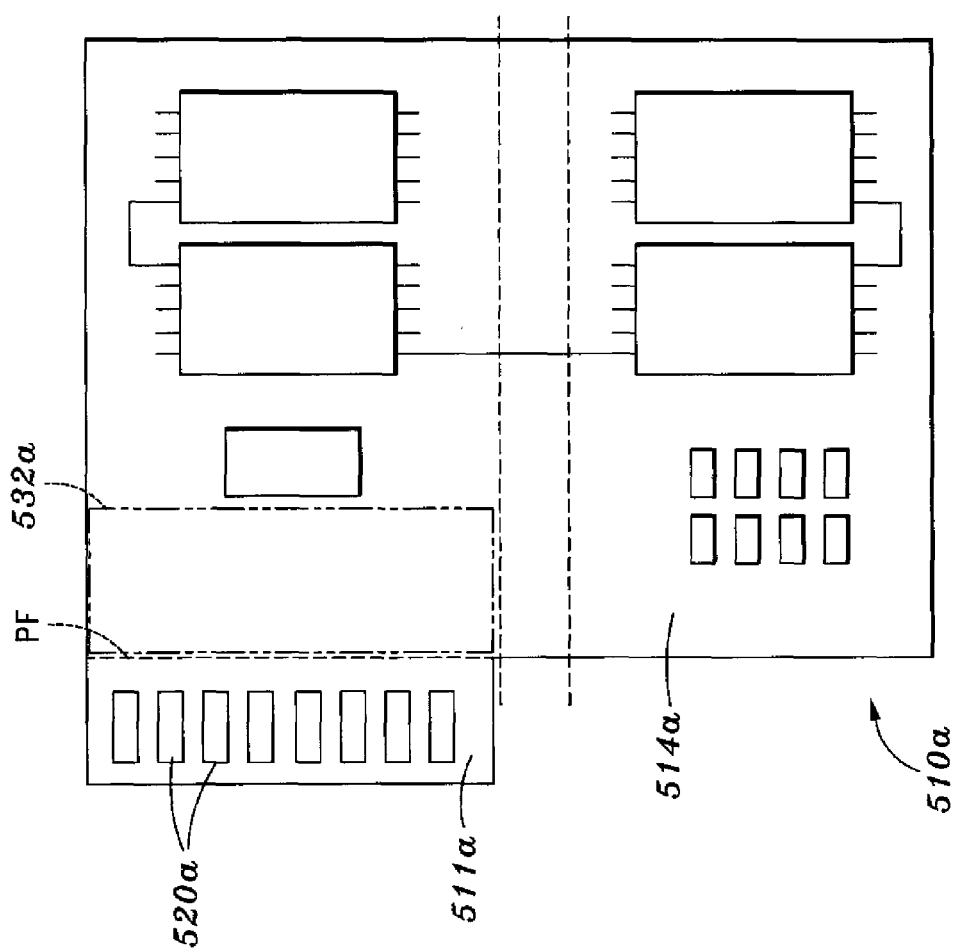


FIG. 8

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**HIGH DENSITY MEMORY CARD USING
FOLDED FLEX****CROSS-REFERENCE TO RELATED
APPLICATIONS**

Not Applicable

**STATEMENT RE: FEDERALLY SPONSORED
RESEARCH/DEVELOPMENT**

Not Applicable

BACKGROUND OF THE INVENTION**1. Field of the Invention**

The present invention relates generally to memory cards, and more particularly to a memory card (e.g., a multi-media card or secure digital card) comprising a flexible substrate (a "flex") which is integrated in the memory card and folded in a prescribed manner subsequent to having various active and passive devices (e.g., controller and memory devices) surface mounted thereto for purposes of providing the memory card with increased capacity.

2. Description of the Related Art

As is well known in the electronics industry, memory cards are being used in increasing numbers to provide memory storage and other electronic functions for devices such as digital cameras, MP3 players, cellular phones, and personal digital assistants. In this regard, memory cards are provided in various formats, including multi-media cards and secure digital cards.

Many memory cards include a module which itself comprises a printed circuit board (PCB) having a conductive wiring pattern disposed thereon. Attached to one side or surface of the PCB and electrically connected to the conductive pattern thereof is a plurality of electronic circuit devices, such as semiconductor packages, semiconductor dies, and/or passive elements. These electronic circuit devices and a portion of the PCB are often covered or encapsulated by an encapsulant material. The PCB also includes a plurality of input/output (I/O) pads or external signal contacts (ESCs) disposed on the side or surface thereof opposite that having the electronic circuit devices thereon. These contacts are not covered by the encapsulant material, and thus are exposed in the completed module which comprises the PCB, the electronic circuit devices and the encapsulant material. Attached to the module is a skin or case of the memory card, such case generally defining the outer appearance of the memory card. The module is coupled to the case such that the contacts disposed on the PCB are not covered by the case, and thus remain exposed in the fully assembled memory card. These contacts of the memory card provide an external interface for an insertion point or socket. The completed memory card has a generally rectangular configuration, with most memory cards including a chamfer formed at one edge thereof which is adjacent to the contacts. In an effort to simplify the process steps needed to fabricate the memory card, there has been developed various memory cards wherein the case is eliminated by applying the encapsulant material the electronic devices and to the PCB such that the encapsulant material hardens into a cover or body of the memory card which is sized and configured to meet or achieve a desired "form factor" for the memory card.

Memory cards, as currently known, have a prescribed data storage capacity, such capacity corresponding to the electronic circuit devices integrated into the module. In conven-

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tional memory cards, the electronic circuit devices of the module include controllers and memory devices which store data and output it under the control of the controller. Since mobile devices such as digital cameras, digital camcorders, MP3 players and telecommunication devices need more data to implement various functions and services, there has been a corresponding increase in the need for increased data storage capacity in relation to the memory cards used in such mobile devices. At the current pace of technological development, the necessary data storage capacity of memory cards is doubling approximately every six months.

The present invention addresses the need for memory cards of increased capacity by providing a memory card comprising a flexible substrate (a "flex") which is integrated in the memory card and folded in a prescribed manner subsequent to having various active and passive devices (e.g., controller and memory devices) surface mounted thereto. The use of folded flex technology in the memory card of the present invention allows the same to support four or more standard, pre-packaged memory devices, thus providing the memory card with substantially increased capacity. These and other attributes of the present invention will be described in more detail below.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided various embodiments of a memory card comprising a flexible substrate (a "flex") which is integrated in the memory card and folded in a prescribed manner subsequent to having various active and passive devices (e.g., controller and memory devices) surface mounted thereto. The active and passive devices are attached to a common side of the flex, and electrically connected to a conductive pattern disposed thereon. The conductive pattern itself electrically communicates with external signal contacts also formed on the flex. In certain embodiments of the memory card, the contacts are formed on a side of the flex opposite that having the active and passive devices mounted and electrically connected thereto. In another embodiment, the contacts are formed on that side of the flex also having the active and passive devices mounted and electrically connected thereto.

Also integrated into the memory card of the present invention is a stiffener which is attached to the side of the flex opposite that having the contacts formed thereon, and is positioned so as to extend along and provide a firm support base for the contacts. In the present memory card, the active and passive devices, the stiffener and portions of the flex are covered by a housing or body formed from a hardened encapsulant material applied thereto. The use of folded flex technology in the memory card of the present invention allows the same to support four or more standard, pre-packaged memory devices, thus providing the memory card with substantially increased capacity.

The present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

These, as well as other features of the present invention, will become more apparent upon reference to the drawings wherein:

FIG. 1 is a cross-sectional view of a memory card constructed in accordance with a first embodiment of the present invention;

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FIG. 1A is a cross-sectional view taken along line A-A of FIG. 1;

FIG. 1B is a top plan view of the flex of the memory card shown in FIGS. 1 and 1A in an unfolded state subsequent to the surface mounting of the active and passive devices of the memory card thereto;

FIG. 2 is a cross-sectional view of a memory card constructed in accordance with a second embodiment of the present invention;

FIG. 2A is a cross-sectional view taken along line A-A of FIG. 2;

FIG. 2B is a top plan view of the flex of the memory card shown in FIGS. 2 and 2A in an unfolded state subsequent to the surface mounting of the active and passive devices of the memory card thereto;

FIG. 3 is a cross-sectional view of a memory card constructed in accordance with a third embodiment of the present invention;

FIG. 3A is a cross-sectional view taken along line A-A of FIG. 3;

FIG. 3B is a top plan view of the flex of the memory card shown in FIGS. 3 and 3A in an unfolded state subsequent to the surface mounting of the active and passive devices of the memory card thereto;

FIG. 4 is a cross-sectional view of a memory card constructed in accordance with a fourth embodiment of the present invention;

FIG. 4A is a top plan view of the flex of the memory card shown in FIGS. 4 and 4A in an unfolded state subsequent to the surface mounting of the active and passive devices of the memory card thereto;

FIG. 5 is a cross-sectional view of a memory card constructed in accordance with a fifth embodiment of the present invention;

FIG. 5A is a cross-sectional view taken along line A-A of FIG. 5;

FIG. 5B is a top plan view of the flex of the memory card shown in FIGS. 5 and 5A in an unfolded state subsequent to the surface mounting of the active and passive devices of the memory card thereto;

FIG. 6 is a cross-sectional view of a memory card constructed in accordance with a sixth embodiment of the present invention;

FIG. 7 is a top plan view of an alternative flex in an unfolded state which may optionally be integrated into any of the memory cards of the embodiments shown in FIGS. 1-4; and

FIG. 8 is a top plan view of an alternative flex in an unfolded state which may optionally be integrated into the memory card of the embodiment shown in FIG. 5.

Common reference numerals are used throughout the drawings and the detailed description to indicate the same elements.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein the showings are for purposes of illustrating preferred embodiments of the present invention only, and not for purposes of limiting the same, FIGS. 1-1B depict a memory card 100 constructed in accordance with a first embodiment of the present invention. The memory card 100, as well as the memory cards of other embodiments of the present invention which will be described in more detail below, may be a multi-media card (MMC), a reduced size multi-media card (RSMC), a secure digital (SD) card, or similar memory cards.

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The memory card 100 includes a flexible substrate 110, hereinafter referred to as the flex 110. The flex 110 is preferably an insulative sheet which defines a generally planar bottom surface 112 and an opposed, generally planar top surface 114. The flex 110 has a generally quadrangular (e.g., rectangular) configuration defining an opposed pair of longitudinally extending peripheral edge segments 116a, 116b and an opposed pair of laterally extending peripheral edge segments 118a, 118b. Disposed on the bottom surface 112 of the flex 110 is a plurality of external signal contacts (ESCs) 120. As shown in FIG. 1B, the contacts 120 are arranged in a single row which extends in close proximity and in generally parallel relation to the lateral peripheral edge segment 118a of the flex 110. As will be recognized, the contacts 120 are used to facilitate the electrical connection of the memory card 100 to the pins or contacts within the host socket of an external device with which the memory card 100 is to be used. Disposed on the top surface 114 of the flex 110 is a conductive pattern 122, only a portion of which is shown in FIG. 1B. The conductive pattern 122 is placed into electrical communication with the contacts 120 on the bottom surface 112 through a conductive medium formed through and/or upon the flex 110. Such conductive medium may include conductive vias and/or conductive traces which extend through and/or along the flex 110.

Mounted to the top surface 114 of the flex 110 and electrically connected to the conductive pattern 122 disposed thereon is a plurality of memory devices 124. Each memory device 124 may comprise flash memory having a prescribed data storage capacity. As shown in FIG. 1B, the memory devices 124 are mounted to the flex 110 in a manner wherein they are segregated into a first pair or set which is disposed in relative close proximity to the lateral peripheral edge segment 118a, and a second pair or set which is disposed in relative close proximity to the lateral peripheral edge segment 118b. In addition to the memory devices 124, also mounted to the top surface 114 of the flex 110 and electrically connected to the conductive pattern 122 is a controller device 126. As also shown in FIG. 1B, it is contemplated that the controller device 126 will be located between the memory devices 124 of the second set and the lateral peripheral edge segment 118b of the flex 110. The controller device 126 preferably comprises a semiconductor die having the logic necessary for controlling the operation of the memory card 100. Since the controller device 126 is electrically connected to the memory devices 124 by the conductive pattern 122, the controller device 126 is operative to control the processes of the memory card 100 for transmitting/receiving data to/from an external device and storing data on the memory devices 124.

As shown in FIG. 1, the controller device 126 is electrically connected to the conductive pattern 122 through the use of a flip-chip type connection, though wire bond or surface mount type connections may also be used to facilitate such electrical connection. In contrast, the electrical connection of the memory devices 124 to the conductive pattern 122 is facilitated by electrically connecting leads 128 of each of the memory devices 124 to the conductive pattern 122. However, those of ordinary skill in the art will recognize that, depending on the configuration of the memory devices 124, a flip-chip connection may also be used to facilitate the electrical connection thereof to the conductive pattern 122. In the event such flip-chip type connection is not employed to facilitate the electrical connection of the memory devices 124 to the conductive pattern 122 (i.e., the electrical connection is facilitated by the use of the leads 128), it is also contemplated that the mounting of the memory devices 124 to the flex 110 may

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be assisted by interposing a layer of a suitable adhesive between each memory device **124** and the top surface **114** of the flex **110**.

As is further seen in FIG. **1B**, in addition to the memory and controller devices **124**, **126**, the memory card **100** is preferably provided with a plurality of passive devices **130** which are also mounted to the top surface **114** of the flex **110** and electrically connected to the conductive pattern **122** thereof. Like the controller device **126**, it is contemplated that the passive devices **130** will be located between the memory devices **124** of the second set and the lateral peripheral edge segment **118b** of the flex **110**. It is also contemplated that a flip-chip interconnection will also be used to facilitate the electrical connection of the passive devices **130** to the conductive pattern **122**. As will be recognized by those of ordinary skill in the art, the conductive pattern **122** and the above-described conductive medium may be used to facilitate the placement of the memory, controller and passive devices **124**, **126**, **130** into electrical communication with each other and with the contacts **120** in any desired pattern or arrangement. Further, the type, number and arrangement of the memory, controller and passive devices **124**, **126**, **130** may be varied from that shown in FIG. **1B** depending on the desired application for the memory card **100**, without necessarily departing from the spirit and scope of the present invention. Along these lines, the number of contacts **120** included on the flex **110** is also variable, and may be set in accordance with the particular application for the memory card **100**.

In fabricating the memory card **100**, the flex **110** is originally provided in the unfolded state shown in FIG. **1B**, with the memory, controller and passive devices **124**, **126**, **130** being mounted to the top surface **114** thereof and electrically connected to the conductive pattern **122** in the arrangement also shown in FIG. **1B**. Prior or subsequent to such mounting and electrical connection, a stiffener **132** is adhesively attached to the top surface **114** of the flex **110**. The stiffener **132** preferably has a generally quadrangular (e.g., rectangular) configuration, and is mounted to the flex **110** such that one of the longitudinal sides of the stiffener **132** extends along and in generally flush relation to the lateral peripheral edge segment **118a**, with each of the lateral sides of the stiffener **132** extending along and in substantially flush relation with portions of respective ones of the longitudinal peripheral edge segments **116a**, **116b**. The preferred width of the stiffener **132** is also such that, when affixed to the flex **110**, the stiffener **132** overlaps the entirety of the contacts **120** located in opposed relation thereto on the bottom surface **112** of the flex **110**.

Subsequent to the mounting of the stiffener **132** to the flex **110** in the above-described manner, the flex **110** is folded along a first set of fold lines **F1** and a second set of fold lines **F2** which are also shown in FIG. **1B**. The folding of the flex **110** along the fold lines **F1** effectively places the top surfaces of the memory devices **124** of the second set (the top surfaces being those surfaces disposed furthest from the flex **110**) in direct engagement with the top surfaces of the memory devices **124** of the first set disposed closest to the contacts **120** in the manner best shown in FIG. **1**. The folding of the flex **110** along the fold lines **F1** also causes the controller device **126** and the passive devices **130** to assume positions disposed generally above and in spaced relation to the stiffener **132**, as also shown in FIG. **1**. The folding of the flex **110** along the fold lines **F2** facilitates the formation of a step **134** in the flex **110** which results in that portion of the flex **110** having the stiffener **132** mounted thereto and the contacts **120** formed thereon (i.e., the portion of the flex **110** extending between the lateral peripheral edge segment **118a** and the fold line **F2** closest thereto) being offset or slightly elevated relative to

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that portion of the flex **110** extending between the fold lines **F1**, **F2** closest to each other. As is apparent from the foregoing, as a result of the folding of the flex **110** in the above-described manner, the folded flex **110** defines juxtaposed portions having the memory, controller and passive devices **124**, **126**, **130** disposed therebetween. Stated another way, the folded flex **110** defines a partially enclosed interior cavity which accommodates the memory, controller and passive devices **124**, **126**, **130**, as well as the stiffener **132**.

After the flex **110** has been folded along the fold lines **F1**, **F2** in the above-described manner, a layer of encapsulant material is applied to the folded flex **110**, such encapsulant material ultimately hardening into a body **136** of the memory card **100**. More particularly, the encapsulant material is injected or otherwise channeled into the above-described partially enclosed interior cavity defined by the folded flex **110**. As best shown in FIG. **1**, the fully formed body **136** covers the memory, controller and passive devices **124**, **126**, **130**, the stiffener **132**, and the entirety of the exposed portion of the top surface **114** of the flex **110**, including the conductive pattern **122** disposed thereon. As seen in FIGS. **1** and **1A**, the fully formed body **136** also defines a generally planar front or leading side **138** which extends forwardly of and slightly beyond the vertically aligned lateral peripheral edge segments **118a**, **118b** of the folded flex **110**, and a generally planar rear or trailing side **140** which extends slightly rearwardly beyond and thus covers that portion of the bottom surface **112** of the folded flex **110** which extends between the fold lines **F1** thereof. The body **136** further defines an opposed pair of generally planar side surfaces **142a**, **142b** which extend slightly outwardly beyond respective ones of the longitudinal peripheral edge segments **116a**, **116b** of the folded flex **110**, as shown in FIG. **1A**.

In the memory card **100**, the height of the leading side **138** of the body **136** is slightly less than that of the trailing side **140** thereof. Advantageously, the formation of the step **134** in the flex **110** accommodates this height differential and allows the contacts **120** to be maintained in generally co-planar relation to a bottom surface **144** of the body **136** which extends to the leading side **138** thereof. Due to the manner in which the body **136** is preferably formed, those portions of the bottom surface **112** of the folded flex **110** extending between the fold lines **F1** and respective ones of the lateral peripheral edge segments **118a**, **118b** of the folded flex **110** remain exposed in the memory card **100** (i.e., only that portion of the bottom surface **112** extending between the fold lines **F1** is covered). However, those of ordinary skill in the art will recognize that alternative configurations of the body **136** are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body **136** may be formed such that the entirety of the bottom surface **112** of the folded flex **110**, except for that portion thereof extending between the lateral peripheral edge segment **118a** and the closest one of the fold lines **F2** thereto, may be covered by the body **136**. Additionally, though the flex **110** is preferably folded along the fold lines **F2** to facilitate the formation of the step **134**, it is also contemplated that the memory card **100** may be formed so as not to include the step **134**, thus eliminating any folding thereof along the fold lines **F2**.

Referring now to FIGS. **2**, **2A** and **2B**, there is shown a memory card **200** constructed in accordance with a second embodiment of the present invention. The memory card **200** of the second embodiment bears substantial similarity in construction to the memory card **100** of the first embodiment, with the **200** series reference numerals in FIGS. **2**, **2A** and **2B** being used to identify the same structures identified by the corresponding **100** series reference numerals included in

FIGS. 1, 1A and 1B. In this regard, only the distinctions between the memory cards **200**, **100** will be discussed below.

In the memory card **200**, the contacts **220** are disposed on the bottom surface **212** of the flex **210**. More particularly, the contacts **220** are arranged in a single row on the bottom surface **212** which extends in close proximity and in generally parallel relation to the lateral peripheral edge segment **218a** of the flex **210**. Additionally, the controller device **226** and passive devices **230** are located on the top surface **214** between the memory devices **224** of the first set and the contacts **220** disposed on the opposed bottom surface **212**, as opposed to being positioned between the memory devices **224** of the second set and the lateral peripheral edge segment **218b** of the flex **210** as described above in relation to the memory card **100**.

In addition, in the memory card **200** the stiffener **232** is adhesively attached to the top surface **214** of the flex **210**. The stiffener **232** is mounted to the flex **210** such that one of the longitudinal sides of the stiffener **232** extends along and in generally flush relation to the lateral peripheral edge segment **218a**, with each of the lateral sides of the stiffener **232** extending along and in substantially flush relation with portions of respective ones of the longitudinal peripheral edge segments **216a**, **216b**. The preferred width of the stiffener **232** is also such that, when affixed to the flex **210**, the stiffener **232** overlaps the entirety of the contacts **220** located in opposed relation thereto on the bottom surface **212** of the flex **210**.

In the memory card **200**, the flex **210** is folded along a first set of fold lines **F1** and a second set of fold lines **F2** which are each shown in FIG. 2B. The folding of the flex **210** along the fold lines **F1** effectively places the top surfaces of the memory devices **224** of the first set disposed closest to the contacts **220** in direct engagement with the top surfaces of the memory devices **224** of the second set disposed closest to the lateral peripheral edge segment **218b** in the manner best shown in FIG. 2. The folding of the flex **210** along the fold lines **F2** results in the stiffener **232** assuming a position disposed generally below and in spaced relation to the controller device **226** and passive devices **230**, as also shown in FIG. 2. The folding of the flex **210** along the fold lines **F2** also facilitates the formation of a step or lateral offset **234** between the portion of the flex **210** extending between the lateral peripheral edge segment **218a** and the closest one of the fold lines **F2** thereto (i.e., that portion of the flex **210** having the stiffener **232** mounted thereto), and the portion of the flex **210** extending between the lateral peripheral edge segment **218b** and the closest one of the fold lines **F1** thereto. As a result, the offset **234** is essentially defined between the vertically aligned, spaced lateral peripheral edge segments **218a**, **218b** of the folded flex **210**.

As best shown in FIGS. 2 and 2A, the fully formed body **236** of the memory card **200** covers the memory, controller and passive devices **224**, **226**, **230**, the stiffener **232**, and the entirety of the exposed portion of the top surface **214** of the flex **210**, including the conductive pattern **222** disposed thereon. The fully formed body **236** also defines a generally planar front or leading side **238** which extends slightly forwardly beyond and thus covers that portion of the bottom surface **212** of the folded flex **210** which extends between the fold lines **F2** thereof, and a generally planar rear or trailing side **240** which extends slightly rearwardly beyond and thus covers that portion of the bottom surface **212** of the folded flex **210** which extends between the fold lines **F1** thereof. The body **236** further defines an opposed pair of generally planar side surfaces **242a**, **242b** which extend slightly outwardly beyond respective ones of the longitudinal peripheral edge segments **216a**, **216b** of the folded flex **210**, as shown in FIG.

2A. Also defined by the body **236** is a shoulder **243** which spans the offset **234** described above.

In the memory card **200**, the height of the leading side **238** of the body **236** is slightly less than that of the trailing side **240** thereof. Advantageously, the formation of the offset **234** and hence the shoulder **243** accommodates this height differential and allows the contacts **220** to be maintained in generally co-planar relation to a bottom surface **244** of the body **236** which extends to the leading side **238** thereof. Due to the manner in which the body **236** is preferably formed, only those portions of the bottom surface **212** of the folded flex **210** extending between the fold lines **F1** and between the fold lines **F2** are covered by the body **236**, the remainder of the bottom surface **212** being exposed in the memory card **200**. However, those of ordinary skill in the art will recognize that alternative configurations of the body **236** are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body **236** may be formed such that the entirety of the bottom surface **212** of the folded flex **210**, except for that portion thereof extending between the lateral peripheral edge segment **218a** and the closest one of fold lines **F2** thereto, may be covered by the body **236**. Additionally, the fold lines **F2** may be configured such that the folding of the flex **210** along such fold lines **F2** does not facilitate the formation of the offset **234**.

Referring now to FIGS. 3, 3A and 3B, there is shown a memory card **300** constructed in accordance with a third embodiment of the present invention. The memory card **300** of the third embodiment bears substantial similarity in construction to the memory cards **100** and **200** of the first and second embodiments, with the 300 series reference numerals in FIGS. 3, 3A and 3B being used to identify the same structures identified by the corresponding 100 and 200 series reference numerals included in FIGS. 1, 1A and 1B and in FIGS. 2, 2A and 2B, respectively. In this regard, only the distinctions between the memory cards **300**, **200** will be discussed below.

In the memory card **300**, the contacts **320** are disposed on the bottom surface **312** of the flex **310**. More particularly, the contacts **320** are arranged in a single row on the bottom surface **312** which extends between the memory devices **324** of the first and second sets disposed on the opposed top surface **314**. Additionally, the controller device **326** and passive devices **330** are located on the top surface **314** between the memory devices **324** of the first and second sets thereof. More particularly, the controller device **326** and passive devices **330** are located on the top surface **314** between the memory devices **324** of the second set disposed closest to the lateral peripheral edge segment **318b** and the contacts **320** disposed on the opposed bottom surface **312** of the flex **310**.

In addition, in the memory card **300** the stiffener **332** is adhesively attached to the top surface **314** of the flex **310**. The stiffener **332** is mounted to the flex **310** such that each of the lateral sides of the stiffener **332** extends along and in substantially flush relation with portions of respective ones of the longitudinal peripheral edge segments **316a**, **316b** of the flex **310**. The preferred width of the stiffener **332** is also such that, when affixed to the flex **310**, the stiffener **332** overlaps the entirety of the contacts **320** located in opposed relation thereto on the bottom surface **312** of the flex **310**.

In the memory card **300**, the flex **310** is folded along a first set of fold lines **F1** and a second set of fold lines **F2** which are each shown in FIG. 3B. The folding of the flex **310** along the fold lines **F1**, **F2** effectively places the top surfaces of the memory devices **324** of the second set disposed to the lateral peripheral edge segment **318b** in direct engagement with the top surfaces of the memory devices **324** of the first set disposed closest to the lateral peripheral edge segment **318a** in

the manner best shown in FIG. 3. The folding of the flex 310 along the fold lines F1, F2 also causes the controller device 326 and the passive devices 330 to assume positions disposed generally above and in spaced relation to the stiffener 332, as also shown in FIG. 3. The folding of the flex 310 along the fold lines F2 further facilitates the formation of a step 334 in the flex 310 which results in that portion of the flex 310 having the stiffener 332 mounted thereto and the contacts 320 formed thereon (i.e., the portion of the flex 310 extending between the fold lines F1, F2 closest to each other) being offset or slightly elevated relative to that portion of the flex 310 extending between the lateral peripheral edge segment 318a and the fold line F2 closest thereto.

As best shown in FIGS. 3 and 3A, the fully formed body 336 of the memory card 300 covers the memory, controller and passive devices 324, 326, 330, the stiffener 332, and the entirety of the exposed portion of the top surface 314 of the flex 310, including the conductive pattern 322 disposed thereon. The fully formed body 336 also defines a generally planar front or leading side 338 which extends slightly forwardly beyond and thus covers that portion of the bottom surface 312 of the folded flex 310 which extends between the fold lines F1 thereof, and a generally planar rear or trailing side 340 which extends slightly rearwardly beyond the vertically aligned lateral peripheral edge segments 318a, 318b of the folded flex 310. The body 336 further defines an opposed pair of generally planar side surfaces 342a, 342b which extend slightly outwardly beyond respective ones of the longitudinal peripheral edge segments 316a, 316b of the folded flex 310, as shown in FIG. 3A.

In the memory card 300, the height of the leading side 338 of the body 336 is slightly less than that of the trailing side 340 thereof. Advantageously, the formation of the step 334 accommodates this height differential and allows the contacts 320 to be maintained in generally co-planar relation to a bottom surface 344 of the body 336 which extends to the leading side 338 thereof. Due to the manner in which the body 336 is preferably formed, only that portion of the bottom surface 312 of the folded flex 310 extending between the fold lines F1 is covered by the body 336, the remainder of the bottom surface 312 being exposed in the memory card 300. However, those of ordinary skill in the art will recognize that alternative configurations of the body 336 are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body 336 may be formed such that the entirety of the bottom surface 312 of the folded flex 310, except for that portion thereof extending between the fold lines F1, F2 disposed closest to each other, may be covered by the body 336. Additionally, though the flex 310 is preferably folded along the fold lines F2 to facilitate the formation of the step 334, it is also contemplated that the memory card 300 may be formed so as not to include the step 334, thus eliminating any folding thereof along the fold lines F2.

Referring now to FIGS. 4 and 4A, there is shown a memory card 400 constructed in accordance with a fourth embodiment of the present invention. The memory card 400 of the fourth embodiment bears similarity in construction to the memory card 100 of the first embodiment, with the 400 series reference numerals in FIGS. 4 and 4A being used to identify the same structures identified by the corresponding 100 series reference numerals included in FIGS. 1, 1A and 1B. In this regard, only the distinctions between the memory cards 400, 100 will be discussed below.

In the memory card 400, the contacts 420 are disposed on the top surface 414 of the flex 410, as opposed to being disposed on the bottom surface 412 of the flex 410 as in the

above-described memory cards 100, 200, 300. More particularly, the contacts 420 are arranged in a single row on the top surface 414 which extends in close proximity and in generally parallel relation to the lateral peripheral edge segment 418a of the flex 410. Additionally, the controller device 426 and passive devices 430 are located on the top surface 414 between the memory devices 424 of the second set and the lateral peripheral edge segment 418b of the flex 410.

In addition, in the memory card 400 the stiffener 432 is adhesively attached to the bottom surface 412 of the flex 410. The stiffener 432 is mounted to the flex 410 such that one of the longitudinal sides of the stiffener 432 extends along and in generally flush relation to the lateral peripheral edge segment 418a, with each of the lateral sides of the stiffener 432 extending along and in substantially flush relation with portions of respective ones of the longitudinal peripheral edge segments 416a, 416b. The preferred width of the stiffener 432 is also such that, when affixed to the flex 410, the stiffener 432 overlaps the entirety of the contacts 420 located in opposed relation thereto on the top surface 414 of the flex 410.

In the memory card 400, the flex 410 is folded along first, second and third sets of fold lines F1, F2, F3 which are shown in FIG. 4A. The folding of the flex 410 along the fold lines F1 effectively places the top surfaces of the memory devices 424 of the second set disposed closest to the peripheral edge segment 418b in direct engagement with the top surfaces of the memory devices 424 of the first set disposed closest to the contacts 420 in the manner best shown in FIG. 4. The folding of the flex 410 along the fold lines F2 facilitates the formation of a sloped section 434 within the flex 410, such sloped section 434 extending between the stiffener 432 and the memory devices 424 of the first set. As a result of the formation of the sloped section 434, that portion of the bottom surface 412 to which the stiffener 432 is attached and that portion of the bottom surface 412 extending between the fold lines F1, F2 which are disposed closest to each other extend along respective ones of a spaced, generally parallel pair of planes.

The folding of the flex 410 along the fold lines F3 causes the stiffener 432 to be partially wrapped by the flex 410 in the manner also shown in FIG. 4. More particularly, the opposed top and bottom surfaces and one of the longitudinal side surfaces of the stiffener 432 are each covered by portions of the bottom surface 412 of the flex 410 as a result of the folding of the flex 410 along the fold lines F3. It is contemplated that the portion of the bottom surface 412 extending between the sloped section 434 and the fold line F3 disposed closest thereto will also be adhesively secured to the stiffener 432 subsequent to the completion of the folding of the flex 410 along the fold lines F3. The folding of the flex 410 along the fold lines F3 also results in the stiffener 432 assuming a position disposed generally below and in spaced relation to the controller device 426 and passive devices 430, as also shown in FIG. 4.

In the memory card 400, the fully formed body 436 covers the memory, controller and passive devices 424, 426, 430, two of the lateral side surfaces and one of the longitudinal side surfaces of the stiffener 432, and the entirety of the exposed portion of the top surface 414 of the flex 410, including the conductive pattern 422 disposed thereon. As seen in FIG. 4, the fully formed body 436 also defines a generally planar front or leading side 438 which extends forwardly of and slightly beyond the lateral peripheral edge segment 418b and the portion of the top surface 414 of the folded flex 410 extending between the fold lines F3, and a generally planar rear or trailing side 440 which extends slightly rearwardly beyond and thus covers that portion of the bottom surface 412

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of the folded flex **410** which extends between the fold lines F1 thereof. The body **436** further defines an opposed pair of generally planar side surfaces which extend slightly outwardly beyond respective ones of the longitudinal peripheral edge segments **416a**, **416b** of the folded flex **410**, in a manner similar to that shown in FIG. 1A.

In the memory card **400**, the height of the leading side **438** of the body **436** is slightly less than that of the trailing side **440** thereof. Advantageously, the formation of the sloped section **434** in the flex **410** assists in accommodating this height differential and allows the contacts **420** to be maintained in generally co-planar relation to a bottom surface **444** of the body **136** which extends to the leading side **438** thereof. Also defined by the body **436** is a shoulder **443** which extends generally perpendicularly relative to the bottom surface **444**. Due to the manner in which the body **436** is preferably formed, only those portions of the bottom surface **412** of the folded flex **410** extending between the fold lines F1 and between the fold lines F2 are covered, along with a small portion of the bottom surface **412** extending between the fold lines F2, F3 disposed closest to each other, as shown in FIG. 4. However, those of ordinary skill in the art will recognize that alternative configurations of the body **436** are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body **436** may be formed such that the entirety of the bottom surface **412** of the folded flex **410** may be covered, with only that portion of the top surface **414** extending between the lateral peripheral edge segment **418a** and the closest one of the fold lines F3 thereto being exposed in the body **436**. Additionally, though the flex **410** is preferably folded along the fold lines F2 to facilitate the formation of the sloped section **434**, it is also contemplated that the memory card **400** may be formed so as not to include the sloped section **434**, thus eliminating any folding thereof along the fold lines F2.

Referring now to FIGS. 5, 5A and 5B, there is shown a memory card **500** constructed in accordance with a fifth embodiment of the present invention. The memory card **500** of the fifth embodiment bears similarity in construction to the memory card **100** of the first embodiment, with the 500 series reference numerals in FIGS. 5, 5A and 5B being used to identify the same structures identified by the corresponding 100 series reference numerals included in FIGS. 1, 1A and 1B. In this regard, only the distinctions between the memory cards **500**, **100** will be discussed below.

The memory card **500** includes a flex **510**. The flex **510** defines a generally planar bottom surface **512** and an opposed, generally planar top surface **514**. The flex **510** has a generally quadrangular (e.g., rectangular) configuration defining an opposed pair of longitudinally extending peripheral edge segments **516a**, **516b** and an opposed pair of laterally extending peripheral edge segments **518a**, **518b**. Disposed on the bottom surface **512** of the flex **510** is a plurality of external signal contacts (ESCs) **520**. As shown in FIG. 5B, the contacts **520** are arranged in a single row which extends in close proximity and in generally parallel relation to the a portion (i.e., approximately one-half of the length) of the longitudinal peripheral edge segment **516a** of the flex **510**. In this regard, one end of the row of the contacts **520** terminated just slightly inward of the lateral peripheral edge segment **518a** of the flex **510**. Disposed on the top surface **514** of the flex **510** is a conductive pattern **522**, only a portion of which is shown in FIG. 5B. The conductive pattern **522** is placed into electrical communication with the contacts **520** on the bottom surface **512** through a conductive medium formed through and/or upon the flex **510**. Such conductive medium may

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include conductive vias and/or conductive traces which extend through and/or along the flex **510**.

Mounted to the top surface **514** of the flex **510** and electrically connected to the conductive pattern **522** disposed thereon is a plurality of memory devices **524**. As shown in FIG. 5B, the memory devices **524** are mounted to the flex **510** in a manner wherein they are segregated into a first pair or set which is disposed in relative close proximity to the lateral peripheral edge segment **518a**, and a second pair or set which is disposed in relative close proximity to the lateral peripheral edge segment **518b**. In addition to the memory devices **524**, also mounted to the top surface **514** of the flex **510** and electrically connected to the conductive pattern **522** is a controller device **526**. As also shown in FIG. 5B, it is contemplated that the controller device **526** will be located between the memory devices **524** of the first set and the longitudinal peripheral edge segment **516a** of the flex **510**. More particularly, the controller device **526** is located on the top surface **514** between the memory devices **524** of the first set and the contacts **520** disposed on the opposed bottom surface **512** of the flex **510**. As is further seen in FIG. 5B, in addition to the memory and controller devices **524**, **526**, the memory card **500** is preferably provided with a plurality of passive devices **530** which are also mounted to the top surface **514** of the flex **510** and electrically connected to the conductive pattern **522** thereof. In the memory card **500**, the passive devices **530** are located between the memory devices **524** of the second set and the longitudinal peripheral edge segment **516a** of the flex **510**.

In fabricating the memory card **500**, the flex **510** is originally provided in the unfolded state shown in FIG. 5B, with the memory, controller and passive devices **524**, **526**, **530** being mounted to the top surface **514** thereof and electrically connected to the conductive pattern **522**. Prior or subsequent to such mounting and electrical connection, a stiffener **532** is adhesively attached to the top surface **514** of the flex **510**. The stiffener **532** preferably has a generally quadrangular (e.g., rectangular) configuration, and is mounted to the flex **510** such that one of the longitudinal sides of the stiffener **532** extends along and in generally flush relation to that portion of the longitudinal peripheral edge **516a** of the flex **510** along which the contacts **520** extend. Additionally, one of the lateral sides of the stiffener **532** extends along and in substantially flush relation to a portion of the lateral peripheral edge segment **518a**. The opposite lateral side of the stiffener **532** extends along and in substantially flush relation to an elongate notch **533** which is disposed in the flex **510**, and extends inwardly from the approximate center of the longitudinal peripheral edge segment **516a** thereof (i.e., the length of the notch **533** and the width of the stiffener **532** are substantially equal to each other). The preferred width of the stiffener **532** is also such that, when affixed to the flex **510**, the stiffener **532** overlaps the entirety of the contacts **520** located in opposed relation thereto on the bottom surface **512** of the flex **510**.

After the stiffener **532** has been mounted to the flex **510** in the above-described manner and the memory, controller and passive devices **524**, **526**, **530** have been electrically connected thereto, the flex **510** is folded along a first set of fold lines F1 and a second set of fold lines F2 which are also shown in FIG. 5B. The folding of the flex **510** along the fold lines F1 effectively places the top surfaces of the memory devices **524** of the second set disposed closest to the lateral peripheral edge segment **518b** in direct engagement with the top surfaces of the memory devices **524** of the first set disposed closest to the contacts **520** in the manner best shown in FIG. 5. The folding of the flex **510** along the fold lines F1 also causes the passive devices **530** to assume positions disposed generally

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above and in spaced relation to the stiffener **532** and controller device **526**, as also shown in FIG. 5. The folding of the flex **510** along the fold lines F2 facilitates the formation of a step **534** in the flex **510** which results in that portion of the flex **510** having the stiffener **532** mounted thereto and the contacts **520** formed thereon (i.e., the portion of the flex **510** extending between the longitudinal peripheral edge segment **516a** and the fold line F2 closest thereto, and between the notch **533** and the lateral peripheral edge segment **518a**) being offset or slightly elevated relative to that portion of the flex **510** extending between the lateral peripheral edge segment **518a** and the fold line F1 disposed closest thereto.

As best shown in FIG. 5, the fully formed body **536** of the memory card **500** covers the memory, controller and passive devices **524**, **526**, **530**, the stiffener **532**, and the entirety of the exposed portion of the top surface **514** of the flex **510**, including the conductive pattern **522** disposed thereon. As seen in FIGS. 5 and 5A, the fully formed body **536** also defines a generally planar front or leading side **538** which extends forwardly of and slightly beyond vertically aligned portions of the longitudinal peripheral edge segment **516a** of the folded flex **510**, and a generally planar rear or trailing side **540** which extends slightly rearwardly beyond vertically aligned portions of the longitudinal peripheral edge segment **516b** of the folded flex **510**. The body **536** further defines a generally planar side surface **542** which extends between vertically aligned portions of the lateral peripheral edge segments **518a**, **518b** of the folded flex **510**, as shown in FIG. 5A.

In the memory card **500**, the height of the leading side **538** of the body **536** is slightly less than that of the trailing side **540** thereof. Advantageously, the formation of the step **534** in the flex **510** accommodates this height differential and allows the contacts **520** to be maintained in generally co-planar relation to a bottom surface **544** of the body **536** which extends to the leading side **538** thereof. Due to the manner in which the body **536** is preferably formed, the bottom surface **512** of the folded flex **510** remains exposed in the memory card **500**. However, those of ordinary skill in the art will recognize that alternative configurations of the body **536** are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body **536** may be formed such that the entirety of the bottom surface **512** of the folded flex **510**, except for that portion thereof extending between the longitudinal peripheral edge segment **516a** and the closest one of the fold lines F2 thereto, may be covered by the body **536**. Additionally, though the flex **510** is preferably folded along the fold lines F2 to facilitate the formation of the step **534**, it is also contemplated that the memory card **500** may be formed so as not to include the step **534**, thus eliminating any folding thereof along the fold lines F2.

Referring now to FIG. 6, there is shown a memory card **600** constructed in accordance with a sixth embodiment of the present invention. The memory card **600** comprises a rigid laminate substrate **610** which defines a generally planar bottom surface **612** and an opposed, generally planar top surface **614**. It is contemplated that the rigid laminate substrate **610** will have a generally quadrangular (e.g., rectangular) configuration defining opposed pairs of elongate peripheral edge segments. Disposed on the top surface **614** is a conductive pattern (not shown).

Mounted to the top surface **614** of the laminate substrate **610** and electrically connected to the conductive pattern disposed thereon is a plurality of memory devices **624**. The memory devices **624** are preferably segregated into a number of stacks, with each such stack including a bottom memory device **624** which is attached to the top surface **614** and electrically connected to the conductive pattern of the lami-

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nate substrate **610**, and a top memory device **624** which is disposed on and electrically connected to the bottom memory device **624** of the corresponding stack. In addition to the memory devices **624**, also mounted to the top surface **614** of the laminate substrate **610** and electrically connected to the conductive pattern thereon is a controller device **626** and at least one passive device **630**. The controller and passive devices **626**, **630** are each electrically connected to the conductive pattern of the laminate substrate **610** through the use of a flip-chip type connection, though wire bond or surface mount type connections may also be used to facilitate such electrical connection. Each memory device **624** may comprise flash memory having a prescribed data storage capacity. The controller device **626** preferably comprises a semiconductor die having the logic necessary for controlling the operation of the memory card **600**. Since the controller device **626** is electrically connected to the memory devices **624** of the stacks thereof included in the memory card **600** by the conductive pattern of the laminate substrate **610**, the controller device **626** is operative to control to the processes of the memory card **600**. Those of ordinary skill in the art will recognize that the memory devices **624** integrated into the memory card **100** need not necessarily be provided in a stacked arrangement therein.

The memory card **600** further comprises a flexible substrate **608**, hereinafter referred to as the flex **608**. The flex **608** is preferably an insulative sheet which defines a generally planar bottom surface **616** and an opposed, generally planar top surface **618**. The flex **608** has a generally quadrangular (e.g., rectangular) configuration defining opposed pairs of longitudinally and laterally extending peripheral edge segments. The memory card **600** also includes a stiffener **632** which is adhesively attached to the bottom surface **616** of the flex **608**. The stiffener **632** preferably has a generally quadrangular (e.g., rectangular) configuration, and is mounted to the flex **608** such that the longitudinal and lateral sides of the stiffener **632** extend along and in generally flush relation to respective ones of the longitudinal and lateral peripheral edge segments defined by the flex **608**. Disposed on that surface of the stiffener **632** opposite that attached to the bottom surface **616** of the flex **608** is a plurality of external signal contacts (ESCs) **620**. As will be recognized, the contacts **620** are used to facilitate the electrical connection of the memory card **600** to the pins or contacts within the host socket of an external device with which the memory card **600** is to be used. Disposed on the top surface **618** of the flex **608** is a conductive pattern. The conductive pattern on the top surface **618** is placed into electrical communication with the contacts **620** on the stiffener **632** through the use of a conductive medium formed through and/or upon the flex **608** and stiffener **632**. Such conductive medium may include conductive vias and/or conductive traces which extend through and/or along the flex **608** and stiffener **632**.

In the memory card **600**, one of the longitudinal peripheral edge segments of the flex **608** is attached to a corresponding one of the peripheral edge segments of the laminate substrate **610**. Such attachment is also facilitated in a manner wherein the conductive pattern of the flex **608** is placed into electrical communication with the conductive pattern of the laminate substrate **610**. As a result, the communicating conductive patterns effectively place both the memory devices **624** and controller **626** into electrical communication with the contacts **620**. As shown in FIG. 6, it is contemplated that the controller and passive devices **626**, **630** will be located on the top surface **614** between the flex **608** and the memory devices **624**.

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The attachment of the flex **608** to the laminate substrate **610** is preferably completed in a manner wherein the flex **608** defines a step **634**, thus resulting in that portion of the flex **608** having the stiffener **632** attached thereto and the laminate substrate **610** extending along respective ones of a spaced, generally parallel pair of planes. As is shown in phantom in FIG. 6, it is contemplated that the controller and passive devices **626**, **630** may alternatively be placed directly upon and electrically connected to the conductive pattern disposed on the top surface **618** of the flex **608**.

The memory card **600** further comprises a layer of encapsulant material which ultimately hardens into a body **636** of the memory card **600**. As shown in FIG. 6, the fully formed body **636** covers the memory, controller and passive devices **624**, **626**, **630**, and the entirety of the top surfaces **614**, **618** of the laminate substrate **610** and flex **608**, respectively. The fully formed body **636** also defines a generally planar front of leading side **638** which extends forwardly of and slightly beyond the flex **608**, and a generally planar rear or trailing side **640** which extends slightly rearwardly beyond the laminate substrate **610**.

In the memory card **600**, the height of the leading side **638** of the body **636** is slightly less than that of the trailing side **640** thereof. The formation of the step **634** in the flex **608** accommodates this height differential and allows the contacts **620** to be maintained in relative close proximity to a bottom surface **644** of the body **636** which extends to the leading side **638** thereof. Due to the manner in which the body **636** is preferably formed, both the bottom surface **616** of the flex **608**, the stiffener **632**, and the bottom surface **612** of the laminate substrate **610** remain exposed therein. However, those of ordinary skill in the art will recognize that alternative configurations of the body **636** are contemplated to be within the spirit and scope of the present invention. For example, it is contemplated that the body **636** may be formed such that the entirety of the bottom surface **612** of the laminate substrate **610** is covered thereby. It is also contemplated that the memory card **600** may be formed so as not to include the step **634** in the flex **608**.

Referring now to FIG. 7, there is shown a flex **110a** which may be integrated into the memory card **100** of the first embodiment as an alternative to the above-described flex **110**. The flex **110a** is also an insulative sheet which defines a generally planar bottom surface and an opposed, generally planar top surface **114a**. Disposed on the bottom surface is a plurality of external signal contacts (ESCs) **120a**. Disposed on the top surface **114a** is a conductive pattern **122a**. The conductive pattern **122a** is placed into electrical communication with the contacts **120a** through a conductive medium formed through and/or on the flex **110a**. Such conductive medium may include conductive vias and/or conductive traces which extend through and/or along the flex **110a**.

Mounted to the top surface **114a** of the flex **110a** and electrically connected to the conductive pattern **122a** disposed thereon are a plurality of memory devices **124a**, a controller device **126a** and a plurality of passive devices **130a**. The orientation of the contacts **120a** on the bottom surface of the flex **110a** and the orientation of the memory, controller and passive devices **124a**, **126a**, **130a** on the top surface **114a** is identical to that described above in relation to the contacts **120** and the memory, controller and passive devices **124**, **126**, **130** of the flex **110** shown in FIG. 1B. In this regard, the sole distinction between the flex **110a** and the flex **110** lies in the addition of an integral pair of ear portions **111a**, **113a** to the flex **110a**. As shown in FIG. 7, the flex **110a** includes preliminary fold lines PF which extend between the ear portions **111a**, **113a** and the remainder of the flex **110a**

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which has a generally quadrangular (e.g., rectangular) configuration. The inclusion of the ear portions **111a**, **113a** allows the flex **110a** to accommodate the conductive pattern **122a** which is of a size/configuration exceeding that of the conductive pattern **122**, and thus requires the additional area provided by the ear portions **111a**, **113a** in the flex **110a**.

In the flex **110a**, it is contemplated that either prior or subsequent to the electrical connection of the memory, controller and passive devices **124a**, **126a**, **130a** to the conductive pattern **122a**, the ear portions **111a**, **113a** will be folded along the fold lines PF, and secured via an adhesive to corresponding portions of the bottom surface of the flex **110a**. As will be recognized by those of ordinary skill in the art, the folding of the ear portions **111a**, **113a** along the fold lines PF causes the flex **110a** to assume the same basic configuration as that shown in FIG. 1B in relation to the flex **110**. Additionally, those of ordinary skill in the art will recognize that the flexes **210**, **310** and **410** described above may likewise be modified to include ear portions similar to the ear portions **111a**, **113a** described in relation to the flex **110a**.

Referring now to FIG. 8, there is shown a flex **510a** which may be integrated into the memory card **500** as an alternative to the above-described flex **510**. The flex **510a** is also an insulative sheet which defines a generally planar bottom surface and an opposed, generally planar top surface **514a**. Though not shown in FIG. 8, disposed on the top surface **514a** is a conductive pattern, while mounted to the top surface **514a** and electrically connected to the conductive pattern are a plurality of memory devices, a controller device and a plurality of passive devices. The orientation of these memory, controller and passive devices on the top surface **514a** may be identical to or substantially similar to that described above in relation to the memory, controller and passive devices **524**, **526** and **530** of the flex **10** shown in FIG. 5B. In this regard, the primary distinction between the flex **510a** and the flex **510** lies in the addition of an integral ear portion **511a** to the flex **510a**. As shown in FIG. 8, the flex **510a** includes a preliminary fold line PF which extends between the ear portion **511a** and the remainder of the flex **510a** which has a generally quadrangular configuration. The ear portion **511a** defines a top surface which, when the flex **510a** is in its fully unfolded state as shown in FIG. 8, is continuous with the top surface **514a**. Disposed on the top surface of the ear portion **511a** are the contacts **520a** of the flex **510a**, such contacts **520a** being electrically connected to the conductive pattern of the flex **510a**.

In the flex **510a**, it is contemplated that either prior or subsequent to the electrical connection of the memory, controller and passive devices to the conductive pattern thereof, the ear portion **511a** will be folded along the fold line PF, and secured via an adhesive to a corresponding portion on the bottom surface of the flex **510a**. As will be recognized by those of ordinary skill in the art, the folding of the ear portion **511a** along the fold line PF causes the flex **510a** to assume the same basic configuration as that shown in FIG. 5B in relation to the flex **510**. As is shown in phantom in FIG. 8, it is contemplated that the stiffener **532a** which will be used in conjunction with the flex **510a** may be attached to a portion of the top surface **514a** which causes the stiffener **532a** to overlap and thus provide structural support to the contacts **520a** disposed on the folded over ear portion **511a**.

This disclosure provides exemplary embodiments of the present invention. The scope of the present invention is not limited by these exemplary embodiments. Numerous variations, whether explicitly provided for by the specification or implied by the specification, such as variations in structure,

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dimension, type of material and manufacturing process, may be implemented by one skilled in the art in view of this disclosure.

What is claimed is:

1. A memory card comprising:

a flexible substrate having a conductive pattern and a plurality of contacts which are each formed directly thereon, the contacts being electrically connected to the conductive pattern;

a plurality of electronic components mounted to the substrate and electrically connected to the conductive pattern on the substrate, the substrate being configured in a manner wherein the electronic components are disposed between juxtaposed portions of the substrate; and

a body formed between the juxtaposed portions of the substrate and covering each of the electronic components;

wherein the contacts are not covered by the body and are positioned on the substrate so as to be exposed in the memory card.

2. The memory card of claim 1 wherein the body is formed such that at least a portion of the substrate is completely covered thereby, and wherein the body defines a leading side adjacent the plurality of contacts and an opposed trailing side, wherein the height of the leading side is less than the height of the trailing side so that the plurality of contacts are generally co-planar to a surface of the flexible substrate that extends toward the leading side thereof, and wherein the body covers opposing sides of the flexible substrate at one of the leading side or the trailing side.

3. The memory card of claim 1 wherein the substrate defines an interior surface having the conductive pattern formed directly thereon and the electronic components mounted thereto, and an exterior surface having the contacts formed directly thereon.

4. The memory card of claim 3 further comprising a stiffener attached to the substrate to provide structural support to the contacts formed directly thereon.

5. The memory card of claim 4 wherein the stiffener is attached to the interior surface at a location which is disposed in opposed relation to contacts formed directly on the exterior surface, and is covered by the body, and wherein the stiffener overlaps the entirety of the plurality of contacts.

6. The memory card of claim 4 wherein the stiffener is at least partially wrapped within a portion of the substrate.

7. The memory card of claim 1 wherein at least some of the electronic components are disposed in a stacked arrangement between the juxtaposed portions of the substrate.

8. The memory card of claim 7 wherein the electronic components comprise active and passive devices.

9. The memory card of claim 8 wherein the active devices comprise a controller device and a plurality of memory devices, and the memory devices are arranged in stacked pairs between the juxtaposed portions of the substrate.

10. The memory card of claim 1 wherein the substrate includes at least one ear portion which has at least a portion of the conductive pattern formed directly thereon.

11. The memory card of claim 1 wherein the substrate includes at least one ear portion which has the contacts formed directly thereon.

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12. A memory card comprising:

a continuous, flexible substrate defining a partially enclosed interior cavity and including a plurality of contacts which are formed directly thereon;

a plurality of electronic components disposed within the interior cavity and electrically connected to the contacts; and

a body at least partially filling the interior cavity and covering each of the electronic components disposed therein;

wherein the contacts are not disposed within the interior cavity so as to be exposed in the memory card.

13. The memory card of claim 12 wherein the substrate includes a conductive pattern which is at least partially disposed within the interior cavity and electrically connected to the contacts, the electronic components being electrically connected to the conductive pattern.

14. The memory card of claim 12 wherein the body is formed such that at least a portion of the substrate is completely covered thereby, and wherein the body defines a leading side adjacent the plurality of contacts and an opposed trailing side, wherein the height of the leading side is less than the height of the trailing side so that the plurality of contacts are generally co-planar to a surface of the flexible substrate that extends toward the leading side thereof, and wherein the body covers opposing sides of the flexible substrate at one of the leading side or the trailing side.

15. The memory card of claim 12 further comprising a stiffener attached to the substrate to provide structural support to the contacts formed directly thereon.

16. The memory card of claim 15 wherein the stiffener is disposed within the interior cavity at a location which is disposed in overlapping relation to contacts, and is covered by the body.

17. The memory card of claim 12 wherein at least some of the electronic components are disposed in a stacked arrangement within the interior cavity of the substrate.

18. The memory card of claim 12 wherein the substrate includes at least one ear portion which has the contacts formed directly thereon.

19. The memory card of claim 13 wherein the substrate includes at least one ear portion which has at least a portion of the conductive pattern formed directly thereon.

20. A memory card comprising:

a rigid substrate having a peripheral edge and a conductive pattern which is formed directly thereon;

a flexible substrate having a peripheral edge and a plurality of contacts which are formed directly thereon, portions of the peripheral edges of the flexible substrate and the rigid substrate being attached to each other such that the contacts are electrically connected to the conductive pattern;

a plurality of electronic components mounted to the rigid substrate and electrically connected to the conductive pattern; and

a body partially covering the rigid and flexible substrates such that each of the electronic components are encapsulated by the body and the contacts are exposed in the memory card.

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